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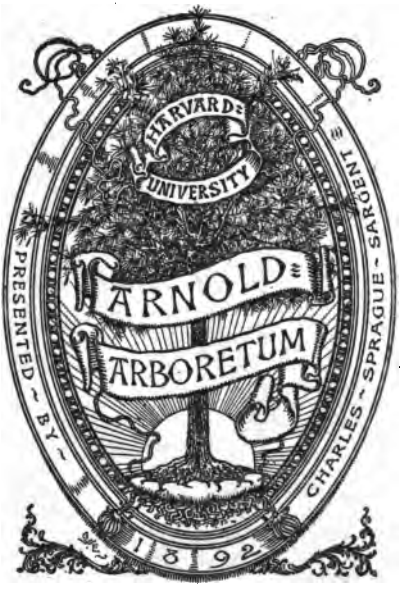
HARVARD UNIVERSITY
ARNOLD ARBORETUM
PRESENTED BY CHARLES SPRAGUE SARGENT
1892

A TREATISE

ON THE

NATURE OF TREES,

AND THE

PRUNING OF TIMBER TREES;

SHOWING

THE IMPOSSIBILITY OF INCREASING THE QUANTITY,
OR IMPROVING THE QUALITY OF TIMBER
BY PRUNING.

BY STEPHEN BALLARD.

LEDBURY:

PRINTED AND SOLD BY THOMAS WARD:
SOLD ALSO BY
WHITTAKER AND CO., AVE MARIA LANE, LONDON.

1833.

Recd Mch. 1901

Entered at Stationer's Hall.

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PREFACE.

THE object of this Treatise is to endeavour to prevent a practice, which through a want of a knowledge of nature, and through ignorance of the baneful effects of counteracting her operations, is carried to an extent that occasions an immense annual loss, and which if universal, would render it difficult to procure sufficient timber to build a single man-of-war.

The great difference and almost infinite variety observable in the shapes of trees, is by some considered a circumstance shewing the necessity of the pruner's aid; when if the causes of the various forms in which trees are found, be investigated, and understood, the variety of shapes will be a clear proof of the impossibility of producing the effects desired by the timber-tree pruners.

The wonderful provisions and careful contrivances in nature for securing the continuance and distribution of each species of vegetable has been observed, and admired by many; but no less wonderful, though less attended to, is the property possessed by every individual vegetable, of attaining, as far as the peculiarities of its situation admit, the full size, which under the most favourable circumstances it would arrive at. In trees this property of economising the space, and turning to advantage the peculiarities of their situations, is obvious. And all the various forms which trees naturally assume, are the best possible for securing the greatest quantity of growth capable of being produced in each particular situation.

The following remarks on the property of trees to adopt the best shape for the situation they occupy, do not relate to the Pine or Fir tribe, the trees of which have a peculiar form from which they cannot depart. The Lombardy Poplar, too, appears to be similar in this respect.

I hope to show the fallacy of pruning with an intention of increasing the growth and bulk of trees, or improving the form, or the quality of the timber. Cutting away dead boughs from trees, or cutting away any jagged part broken by accident, will not be considered as pruning.

In the arrangement of the subject I shall first make some remarks on the nature of trees. This will be the most important part, for the investigation of the habits of trees brings forth the strongest arguments against pruning, and makes manifest the certainty of its injurious consequences. I shall then endeavour to show that by pruning, the quality of timber is injured; the quantity lessened, and that the whole of the pruner's work has a directly opposite effect to that he wishes to obtain, and that his practice is owing to a want of knowledge of the nature of trees.

Probably this work will not meet with the approbation of many professed pruners or other persons concerned in the cultivation of timber; as its purport is to show that their labour has been worse than useless; for often a man will advocate the utility of his practice even when convinced of his error, rather than allow that the greater part of his time has been spent in doing mischief. Yet there are many who have long ago doubted the good effects ascribed to pruning, but I have seen no attempt to show the impossibility of obtaining the ends desired by the forest-tree pruner.*

"When a subject is first brought forward which has the appearance of novelty, however sound and rational the principle may be on which it rests, yet it is with much difficulty the prejudice in favour of established practice can be removed."† But I feel satisfied that some time or other the effects of pruning will be known to be such as I state them; having formerly entertained the notions of the practical pruners, but abandoned them on becoming more acquainted with the nature of trees. I do not expect to stop the injurious practice at once; this can only be effected slowly; but I do hope to hasten its discontinuance.

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* Since this Treatise was written I have seen in the Horticultural Register, the observations on pruning, by the Author of the Domestic Gardener's Manual. He has very ably controverted the doctrine of the pruner, and shown that cutting away boughs diminishes instead of increases the growth of timber.

† Fulton's Treatise on Canal Navigation.

Authors treating on the subject have lately laid particular stress on the great care necessary in pruning, and the great danger there is of doing injury in the performance of the work: but they admit the propriety of the practice. And although these barbarously mutilated monuments of ignorance, stuck up so commonly about the country in the shape of shredded elms and other lopped trees, are not directly approved of by the advocates of *judicious* pruning, it is probable they would be far less frequent, were the real effects of pruning pointed out: for every person, even the hedger, in shredding up the young and thrifty oak imagines his work is performed *judiciously*.

It is not at all strange, that the advocates for pruning should disagree as to which is the best method of performing the work; some say, the boughs should be taken off close to the stem; others, that a part of each pruned bough should be left on the stem; and others, that the extremities only of the branches should be shortened. Each clearly points out the errors of the methods differing from his own. This is done with the greatest ease, for "it is nothing more than a reiterated precept, handed down from one age to another, in the face of the most unquestionable experience of its fallacy."* But it would be a difficult matter to show how pruning is beneficial without going on some false grounds; such as that the branches are robbers, "intercepting and converting to their own use"* the means that would otherwise nourish the stem. Some will say I carry the system too far; that because pruning has been practised to excess, or *injudiciously*, I have fallen into the opposite error in excluding it entirely. But I give the reasons that have led to this conclusion, and would ask the pruner, why, and how, pruning is beneficial. Let him attempt to explain this, and not follow the practice merely because others have done so.

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* Sir H. Steuart's Planter's Guide.

And now, very likely the pruner will say, where did this anti-pruner, who thus presumes to set forth a doctrine in opposition to our established and approved useful practice, obtain his fancied knowledge and experience? I should answer, that few persons have had better opportunities of observing the nature of trees, and the effect of pruning on their growth and on timber, than I have; and that I have availed myself of these opportunities, I hope will appear in the following pages.

I am not induced to publish this book in expectation of pecuniary profit, as I could, if necessary, prove; but convinced of the correctness of my positions by long and attentive observation, and by experiment, I feel compelled to prevent, as much as I am able, a practice that is annually robbing this country of an immense quantity of valuable timber, and shall be amply rewarded for my trouble if in passing through the country I see any trees left unpruned through a knowledge of the certain ill effects of pruning.

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* Pontey's Pruner.

CHAPTER I.

NATURE OF TREES.

Of the power of trees to evade the force of the wind —Balancing-boughs—Strong shape of boughs, stems, and roots—Property of assuming the best shape— Small sprays search out parts favourable for extension—Sir H. Steuart's remarks.

If we examine and consider attentively the nature of a tree, it will be delightful to observe its power of adapting itself to its situation; its strength to resist the winds; its endeavours to repair any injury it may have sustained, and to fill up equally with its branches every airy and light space within its reach; and the beautiful proportion of its sprays, branches, limbs, and stem.

The cutting away the under boughs of trees is of the most injurious consequence, not only on account of the diminished means of forming timber occasioned by the quantity of leaves being lessened, and the incurable wounds inflicted, but also, on account of the mechanical disadvantage a tree has when deprived of its balancing boughs, in resisting the force of the wind. If we examine the effect the wind has on a perfect tree standing by itself, we shall be convinced how necessary the lower boughs are, and how impossible it is to cut or prune any part away without committing injury. A tree, perhaps one hundred feet high, and nearly as wide across the lower branches, and covered with innumerable leaves must have a wonderful power to resist, or to evade, a strong wind. Its powers of evading are admirable; the leaves, for instance, are fixed on footstalks that give way, and the edge of the leaf only is presented to the wind: were it not for this provision, the strongest oaks, when in leaf, would be unable to bear a very moderate gale. The lower, or balancing boughs, through bending towards the earth, receive the wind on their upper surfaces, and its effect on them is converted directly to support the tree; for the direction of the force of the wind is at right angles with the surface it strikes, it therefore presses the limbs next the wind towards the ground, and, of course, the stronger the wind blows, the firmer is the tree by these limbs held to the ground; and if these lower balancing limbs be all perfect, it is almost impossible the tree can be blown up by the roots; the stem would sooner be broken off above the balancing limbs. How much the stability of the tree is increased too, by having its centre of gravity by these large and heavy boughs brought so near the ground. Although so amply provided with the power of evading the wind, yet is it sufficiently provided with strength to resist it. There is great reason to

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tree has the power of adopting the shape that is the best possible for the situation it grows in; and if this be proved, what occasion is there for pruning. Look at a tree in the middle of a grove; it has no under limbs or sprays where there is an insufficiency of light to support leaves, and why has it not? Because there was not sufficient light, or because the situation was not adapted for leaves. Look to the outside of a grove; how comes it that the trees on the outsides have low boughs and limbs on their outsides, where there is plenty of light, and none on their insides situated near other trees; how is it that the boughs happen to be only in such situations as are suited for boughs; that is, where there is plenty of light, and none where there is an insufficiency? This is invariably the case: if two trees be near together, and not near other trees, they have each a flat side, with the boughs extending only where light is.

The branches of a tree fill up the space equally over its head, without growing against each other, and the space is divided equally, and closely filled, with scarcely an instance of the sprays touching each other; notwithstanding they are inclined in every possible direction. If this be considered, it will be plain, that a tree has the power of sending forth branches in such places, and such directions, as are suited for branches and provided with every requisite necessary for the existence of leaves. The pruner sees what he calls an ill-shaped tree; perhaps with boughs extending much farther on one side than another, and immediately sets about correcting it.

He does not consider what was the cause of that which he takes for disproportion, and much less, does he imagine, that the tree will itself, correct that disproportion, if the cause be removed.

I never, yet, have been able to discover a single instance of a tree not shaped in the best possible manner for its situation, when it had not received any external injury. And if it be considered how a tree increases in size, it will be seen, that it is sure to be formed in the best shape for its situation. The circumference of the head of a tree is composed of many sprays; these sprays are annually extended on every side, that is, when there is no obstacle to prevent; but suppose an obstacle be presented to one side, such for instance as a building, this obstacle would obstruct the light; consequently, the sprays on this side would not grow so luxuriantly, but would become weakly, and if the obstacle be so near as to shut off all that is requisite for the existence of leaves, growth in that direction is, of course, stopped. But, if there be a partial supply of the requisites for leaves, then the leaves are proportioned exactly to the supply. In this cautious way does a tree increase in size, without a possibility of error, proving by trial every part of space within its reach; advancing rapidly in such directions as are congenial; and extending in every part, with vigour proportioned to the congeniality of each part. It is pleasing to observe how this rule is adhered to without counteracting the balancing of the tree, or rather the forming of that shape, best suited to resist the wind. If a tree have boughs only on one side, it must have something on the other sides that prevented the growth of boughs there; whatever this be, it serves to shelter the tree from wind, but where the boughs are there is an open space, and of course, more exposed to the wind, and in this direction the tree is prepared to receive the wind; having a tendency by its own gravity to press against the power it has to oppose.

Thus we shall find every thing in nature perfect; no one advantage obtained at the expense of another, as in works of art; but every function performed in the best manner to promote its own particular purpose, and at the same time aiding every other design. "Each modifies and determines the existence of all the others, and is equally affected by all, in its turn."*

The small sprays of a tree may, in one sense, be considered as feelers, sent out in all directions to ascertain what points are favourable for extension, with the power to increase and extend, in proportion as the space is adapted for growth: should any direction prove unfavourable, there is no loss, for extension there is discontinued, and only pursued in such directions as are suited for it. And in this manner do the roots extend, witness the luxuriant growth of roots sometimes seen in drains, roots escaped through holes in flower-pots, and the general preference evinced by roots for a good soil.

Sir H. Steuart says, in his Planter's Guide, "roots are materially determined in their form by the nature of the soil in which they grow; insomuch that, in many instances, before we can pronounce on their true form, we must be aware of the condition and texture of the soil that is most natural to them. Their developement is most luxuriant in ground that is neither too loose nor too dense. In stiff and poor soils they are spare and scraggy; whereas, in such as are at once deep and loose, the minutest fibres both expand and elongate with facility, and render the mouths, that search for food to the plant, almost innumerable."

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* Sir H. Steuart's Planter's Guide.

Mr. Pontey, in the preface to his pruner, says, "if trees were, indeed, cast by nature in a mould, which it would be fruitless, if not impious to attempt to alter, as some authors have gravely asserted, then might we say to improvement, here shall thy proud efforts be stayed; the doctrine, however, betrays an extreme ignorance of the natural and accidental forms in which trees are every where found." Now from what is stated respecting the power of trees, to adapt themselves to the space and situation they have to occupy, I think it will appear, that trees may be said to be cast in moulds; not all in one and the same mould, but, in an infinite number, each tree having its own, exactly suited in the best possible manner to its wants. Were they all cast in one and the same mould, there would be some reason in pruning, as all trees could not be similarly situated; the boughs of one tree would grow against those of another, and would persist in growing in such situations as were not adapted for them. Here, indeed, would be something for the pruner to do. It would not be right to say to improvement, "here shall thy proud efforts be stayed," for there would be great necessity for extraordinary efforts. But, when "we see nature especially accomodating the character of each individual plant to the exigencies of its particular situation:"* we may say to the pruner, "here shall thy proud efforts be stayed;" for thy attempt proves thou art ignorant of the cause of "the natural and accidental forms in which trees are every where found." "The exposure and correction of error, is one of the first steps to genuine knowledge; and when we are aware of the stumbling blocks which have interrupted the progress of others, we can always travel more securely in the way of truth."†

The remarks on the nature of trees, in Sir H. Steuart's Planter's Guide, are just and true, and I will transcribe such as have particularly struck me. "But while every organic creation tends to full developement, that is, to absolute energy, or the perfection of its species, still we find, that the organs, of which it is composed, are each reciprocally dependent on every other, for the possibility and degree of their peculiar action. At the same time, as these internal conditions of animated existence are severally dependent on certain external conditions, which again are not always fully and equally supplied; so it follows, that the life of every organized being is determined in its amount, and in the direction of its developement, by the outward circumstances of its individual situation. For this reason we see, that every animal, and every plant is dependent for its existence, and also for its perfect existence, on conditions both internal and external."

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* Sir H. Steuart. † Insect Architecture, L. E. K.

"From this reasoning it may be conceived, how the several parts of the living whole reciprocally act and react. They are, in fact, cause and effect mutually; and no one can precede another, either in the order of nature, or of time. Thus, in an animal, the digestive and the absorbent, the sanguineous, the respiratory, and the nervous systems are at once relative and correlative. In like manner, in a plant, the same reciprocal proportion is found to hold between the roots and the stem, the branches and the leaves: each modifies and determines the existence of all the others, and is equally affected by all, in its turn. And as their several parts, by means of their union, constitute the organic whole; and as their functions, by the same means, realize the complement of life, which the plant or animal exhibits; so it is evident, that every living individual is a necessary system, in which no one part can be affected, without affecting the other parts, and throughout which there reigns an intimate sympathy, and a complete harmony of perfection and imperfection."

"Further; the external conditions of this internal developement of plants and animals, are Food, Air, Heat, and probably Water; while Light, according to most physiologists, seems to be a peculiar condition, indispensably necessary to plants. Where any one of these conditions is not supplied, the existence of life, whether animal or vegetable, becomes impossible; where it is insufficiently supplied, life is proportionally enfeebled or repressed. But, to limit our considerations to the vegetable kingdom, it may be observed, that where a loose and deep soil affords an abundant supply of food, where a genial climate diffuses warmth in an adequate degree, and where a favourable exposure allows a competent access of light (for air, being fully and universally given, may be thrown out of the case); in these circumstances, a plant, if not mechanically injured, will vigorously exercise its functions, and attain the full developement of its parts, thus realising the absolute complement of life, to which it naturally tends. In the same way, when these conditions are stinted, the luxuriance of the plant is checked, in the ratio of that restraint, and the deficiency of the supply. Where any one of the external conditions is partially or inadequately supplied, the plant appears to make special, and even forced efforts to secure as much of the beneficial influence as it can, and to accomodate itself to the exigency of its situation. Thus, where light is admitted only from a single point, a plant concentrates all its powers in stretching towards the direction of the light. Where light is shed all round, the plant throws out its branches on every side. In conformity with this principle, we find, that, in the interior of a wood, where the trees mutually impede the lateral admission of light, the tendency of each is upwards; and the consequence of this tendency is, that the plant is thereby not developed in its natural and perfect proportions, but is elongated, or drawn up to an undue height. It displays its ramification chiefly near the top; while the imperfection of its life is manifested, in the whole character of its vegetation. In open exposures, on the other hand, the tree developes its existence, in full health and luxuriance. It reaches a height, such as the soil and situation admit, and sufficient to allow the branches, which are thrown out on every side, to expand their leaves freely to the sun. Not being compelled to concentrate its efforts in securing a scanty supply of one beneficial influence, all its proportions are absolute and universal, not relative and particular. In such circumstances, therefore, it may be considered as in a full and natural state of perfection."

"In like manner, in all the other relations, we see nature especially accommodating the character of each individual plant to the exigencies of its particular situation. In the interior of woods, the wind can exert a far less mechanical effect on individual trees; and, therefore, while they are *positively* determined to push upwards towards the light, they are *negatively* permitted to do so, by the removal of any necessity to thicken their trunks, for the sake of greater strength, and to contract the height of them, in order to afford the blast a shorter lever against the roots. But, with trees in an open situation, all this is widely different.

There they are freely exposed to the wind, and the large expansion of their branches gives every advantage to the violence of the storm. Nature, accordingly, bestows greater proportional thickness, and less proportional elevation on trees which are isolated, or nearly so; while their system of root, which, by necessity, is correlatively proportional to their system of top, affords likewise heavier ballast and a stronger anchorage, in order to counteract the greater spread of sail, displayed in the wider expansion of the branches."

"Every individual tree is thus a beautiful system of qualities, specially relative to the place which it holds in creation; of provisions admirably accommodated to the peculiar circumstances of its case. *Here every thing is necessary; nothing is redundant.* In the words of a great philosopher, who was an accurate observer of nature, 'where the necessity is obviated, the remedy, by consequence, is withdrawn'."

"Of trees in the interior of woods, setting aside all technical or phytological distinctions, the following are found to be the general characteristics: stems upright and stately; bark glossy and beautiful: tops small, and thinly provided with branches; with roots, in the same way, spare and scanty, but in due proportion to the tops. In open exposures, on the other hand, the reverse of all this is the case. The characteristics of these are the following: stems stout and short; bark thick and coarse; tops extensive and spreading; branches often reaching to the ground; with roots extensive like the tops, and throwing themselves out on every side. What, then, are we to conclude from these remarkable discrepancies between trees of the same species, although in different situations, but that nature, which orders nothing in vain, has bestowed these properties for wise purposes, and that they are the best calculated, respectively, to realize in those trees as great a complement of life, as their respective circumstances will admit?"

"In considering the characteristics of trees above mentioned, we should always bear in mind, that every production of nature is an end to itself, and that every part of it is, at once, end and mean. Of trees in open exposures we find, that their peculiar properties contribute, in a remarkable manner, to their health and prosperity. In the first place, their shortness and greater girth of stem, in contradistinction to others in the interior of woods, are obviously intended to give to the former greater strength to resist the winds, and a shorter lever to act upon the roots. Secondly, their larger heads, with spreading branches, in consequence of the free access of light, are formed as plainly for the nourishment as well as the balancing of so large a trunk, and also for furnishing a cover, to shield it from the elements. Thirdly, their superior thickness and induration of bark is, in like manner, bestowed for the protection of the sap-vessels, that lie immediately under it, and which, without such defence from cold, could not perform their functions. Fourthly, their greater number and variety of roots are for the double purpose of nourishment and strength; nourishment to support a mass of such magnitude, and strength to contend with the fury of the blast. Such are the obvious purposes, for which these unvarying characteristics of trees in open exposures are conferred upon them. Nor are they conferred equally and indiscriminately on all trees so situated. They seem, by the economy of nature, to be *peculiar adaptations* to the circumstances and wants of each individual, *uniformly bestowed in the ratio of exposure*, greater where that is more conspicuous, and uniformly decreasing, as it becomes less."

"It has been noticed above, that all trees, in open situations, uniformly attain the highest state of natural perfection, of which they are susceptible; consequently it is by such trees, that the best, the toughest, and the most durable timber is produced. Yet it is interesting to observe the beneficence of Providence, in providing for the accommodation of man. Were it not for the way, in which the external conditions of trees in woods and close situations are modified, from whence could we procure the long and powerful beam, the straight, clean, and lengthened deal, and nearly all the wood that is employed, whether in civil or naval architecture?"

Now it is astonishing that the author of the above remarks, should consider it possible to promote the growth of timber by cutting away branches; having in the foregoing observations shown that "*every thing is necessary; nothing is redundant*. I can hardly persuade myself of the possibility of such notions being entertained by one, in many respects, so well acquainted with the nature of trees, and regret that the attention of Sir H. Steuart was not more particularly applied to the effects of pruning on the growth, and quality of timber. He has proved the absurdity of cutting trees, when transplanted, but still left to the discretion of the ignorant, the practice of pruning.

CHAPTER II.

OF NATURAL SHEDDING OF SPRAYS.

Great number of sprays shed—Perfect manner in which the Oak sheds sprays—Fine timber of the forests where there are no pruners.

Trees have the power of pruning themselves; all useless branches die, and drop off. In many kinds of trees, the quantity of branches thus disposed of during the time a tree is coming to maturity, is much greater than the quantity retained, when at maturity. This may, to some persons, seem unlikely; but let it be considered, that the circumference of the head of a tree, proceeds almost from a point; and that the extremities of the branches have been, at some part of the tree's life, in every part of the space within the limits of the space occupied by the head of the tree when at maturity. And let it be remembered how close the twigs, or small sprays, are situated to each other round the head of a tree; and observe how close the whole inside space, within the extremities of the branches, would be filled, had all these small sprays remained on. If this be well considered, some idea may be formed, of the immense number of sprays pruned off in this natural way, by means of this power of discontinuing sprays in such situations as are no longer suitable; and of the advantage the tree has of forming itself in the best possible shape for its situation.

Let the pruner, before he commences his attack upon a tree, observe that its branches are selected, or chosen, from a number many times as great as the quantity left, and that they are the selected few found by experience to be well situated. If he pause and consider this but a little while, he will be humbled, the insufficiency of his judgment will appear, and he will estimate his abilities more according to their value.

I fear that my attempts to show the existence of this natural pruning, may not, to many, appear sufficiently clear; and, therefore, will endeavour to explain more fully; for certainly if it be shown that trees themselves observe, and practise, a system of pruning off useless branches, it must be a strong argument against any interference on the part of man, and especially if man be ignorant of the tree's power of performing the work itself.

I find it difficult to express my ideas sufficiently plain for the general reader, at the same time, am anxious to make known to all, what I have observed in the nature of trees; and if my endeavours fall short of what I wish, still I have hopes, that my observations may call the attention of some to the study of the subject. If those concerned in the growth of timber, would but apply themselves to the investigation of the nature of trees; disregarding any old-fashioned dogmas relative to their management, that may have been handed down to them, they would gain much more extensive information than it is possible to gain from a book. I, therefore, earnestly entreat the cultivators of timber, to apply themselves to the subject, which is now so little understood.

There seems to be a singular want of knowledge, patiently endured, respecting the nature of trees. The investigations of the physiologists are unfortunately confined too much to the internal organization of the sap vessels, and the motion of the sap, and not extended, so much as they should, to the rules, and circumstances that regulate the external form and developement of trees. As a proof of the great want of knowledge of the nature of trees, I need only instance; how little the necessity of selection of trees to be transplanted is, even at the present day, known, and that it was almost wholly unknown before the publication of Sir H. Steuart's valuable book, the Planter's Guide. But to return to the subject of natural pruning. A person who has not contemplated the subject, will hardly believe that the number of sprays retained by a full grown tree, bear but a small proportion to the quantity that tree has, itself pruned off. Now to show that this must be the case, let us trace the growth of a tree—suppose an Oak, from the seed to maturity. The first year's growth of a tree from the seed is, generally, one perpendicular shoot; the second year, side branches are, most likely, formed within a few inches of the ground; this to be sure, depends on the situation of the plant: but a young tree does not proceed, at any rate, far, without side branches. These side branches are, each successive year, extended, and multiplied; so that by the time the tree has attained the height of eight or ten feet, it has many tiers of branches; extended and divided into numerous small sprays. The growth continues; the head, each year extends—the stem thickens—and, let us suppose the tree has reached the height of forty feet. We now find it covered with innumerable sprays, closely filling up the spaces round the circumference of the head. The size of the tree continues to increase; the proportion and symetry of its make, are maintained at all times; and we see, when it has arrived at the height of eighty feet, with a stem probably five feet diameter, its stem and branches bear the same proportion to each other, that they did when the height was forty feet. Compare it now with what it was when but forty feet in height; at that height it had sprays to the number very likely of one thousand; look to the full grown tree, and imagine a space within its boughs equal to the size of the tree at forty feet height. Observe how many boughs the full grown tree has in this space, and you will immediately see, what an immense number of sprays must have been shed. The large limbs extend, perhaps several feet from the stem without any subdivision. There are now no limbs branching out from the stem, within ten feet of the ground; but when the tree was but eight feet high, it had many tiers of branches, extended and divided into many small sprays; and when the tree was still younger, the side branches spread out from the stem within a few inches of the ground. What is become of them? Now, there is not a side branch within ten feet of the ground. The space formerly filled by the stem, branches, and the whole of the young tree at eight years of age, is now occupied by the huge, solid, and beautiful stem of an Oak; not a sign of the side branches, so numerous in the young tree, can be seen, they are all vanished, only the leading shoot remains, and that enlarged to such a size, that it bears not the slightest resemblance to what it was in its youth.

Some imagine that whenever a stem is free from branches, it is owing to pruning or to the browsing of cattle; but this is not the case, it is natural to a timber-tree, be its situation what it may, to have a certain portion of its stem clear of branches.

There are no pruners in the uncultivated forests from whence we have the long pines and deals imported, with often thirty or forty feet of clear stem before the branches begin. These trees have grown without the assistance of the pruner; and they have shed boughs that were far above the reach of cattle. These forests clearly prove that trees have the power of shedding such sprays as are useless, or unnecessary, for a tree could not reach the height of thirty or forty feet without a great number of branches. It must have branches when but a foot or two high; the number and size of these branches must increase as the tree increases in height, and a tree thirty feet in height, must have a great number of branches; yet we have the stems of trees thirty feet high without a single branch. How do the advocates for pruning reconcile this to their philosophy, will they assert that the stem is stretched or protruded, so that the boughs, first situated near the ground are, by the growth and lengthening of the stem, lifted up farther from the earth? this they cannot say: yet they will have great reluctance in admitting the existence of this natural shedding of sprays, for no person who well understands it will ever prune under the idea of improving the shape or increasing the quantity of timber.

It has been stated that it is natural to all trees to have a certain portion of the stem free from branches. The length of the stem clear from branches depends on the situation of the tree. In proportion as the situation is exposed the stem is shorter; but, if it were possible to have a tree grow up to maturity, without ever having its lower boughs either cut off, or destroyed by other trees or bushes, that is, if the ground round about the tree were entirely without any other vegetable whatever, and the situation were open and at the same time the tree protected from any thing that could injure its lower boughs, a tree so situated would, when at maturity, have a portion of its stem free from boughs.

The manner in which the boughs are shed, is much more perfect in some trees than in others. The Oak effects it in the most complete manner. Every one who has at all turned his attention to the growth of the oak, must have observed a number of dead sprays lying under the trees; but the authors of all the works I have read, relating to the management of trees, have omitted to notice these naturally shed sprays.

If the end of one of these sprays be examined, it will be found to resemble the end of the footstalk of a leaf, where it has naturally separated from the spray; it also has an appearance something like the end of a buck's horn, where it has separated from the head of the buck. The shape and appearance of the part that has separated from the tree will convince any one that it is a natural division. The end of the spray is a little convex, and entirely without that jaggedness attending the fracture of living sprays. Now it is after this natural pruning only, that a union takes place between the old and new wood; although many pruners buoy up and encourage themselves with the idea, that the old and new wood unites, where their clumsy operations have been performed: for clumsy indeed, are the operations of the pruner in comparison with those of nature. I may be accused of a want of courtesy; but there is little due to those, who have the assurance to take upon themselves the correction and improvement of a thing, the nature of which they are so ignorant of, as to be unacquainted with the power of trees to discontinue such sprays as are in situations no longer provided with the necessaries for the use of sprays.

If I have succeeded in the attempt to show the necessity of sprays being shed, let not any pruner, blinded with his own sufficiency, imagine this circumstance in favour of pruning. Perhaps it may be said, that it is shown that pruning is a natural operation in the growth of trees, and man, when he performs the work, is assisting nature. But nature does not want this kind of assistance. The only way in which nature can be assisted in the growth of trees, if assistance it must be called, is by improving the situation, and increasing, or bettering the food of the tree. As for instance, the growth of a tree may be encouraged by the removal of surrounding trees; by improving the soil in which it grows; or by protection from any injury it may be liable to. The knife cannot be used on the live part of a tree without inflicting an injury, and lessening the growth. The sprays that drop off of themselves are not shed because they were robbers, but because their situation had become, by the growth of surrounding sprays, unfit, by being made too limited or too dark.

Now do the pruners know which sprays have sufficient room when they cut away so unhesitatingly? If they cut away sprays where there is room for their growth, they, in addition to the injury, by the irreparable blemish inflicted in cutting the wood, retard the growth of the tree. And if they cut away sprays that would of themselves drop off, their labour is useless, and most likely injurious, as the sprays would be removed before there was any necessity. It is worthy of remark, that the young shoots, which seldom fail to show themselves after the pruner's operations, are never to be seen where sprays naturally separate themselves from the tree. All kinds of timber trees practise this natural pruning, but few, that I have observed, in so perfect a manner as the Oak.

CHAPTER III.

Of the power of trees to send forth sprays in every suitable situation—Origin and connection of branches.

Having shown that trees have the power to discontinue sprays in such situations as are not adapted for the purposes of sprays; I shall now endeavour to point out the power of trees to send forth sprays in such situations as are well suited for the existence of sprays and leaves; and for this purpose will make an extract from the work on Vegetable Physiology, in the Library of Useful Knowledge. And when it is understood, that it is the nature of trees to discontinue and throw off such sprays as are ill situated,and to send forth sprays in every part adapted for the growth of sprays; it ought to be admitted that trees are almost certain to be formed in the best manner possible for the situation they are in. This ought to be a sufficient reason to deter any one from cutting trees under the idea of *improving their form*. In another part of this Treatise will be proved, as far as the nature of the subject admits, that the more leaves there are on a tree, the greater is the growth of timber, other circumstances being the same, and this ought to be a sufficient reason to prevent pruning under the idea of *increasing the quantity of timber*, as pruning can never be performed without lessening the quantity of leaves.

"A very clear idea of the origin and connection of branches may be conveyed by the aid of a diagram. Thus, if we imagine the successive years of the growth of a tree to be represented by the cones, *a*, *b b*, *c c*, and *d d*, *fig*. 40, it is evident that the germs furnishing the branches *e f g h*, although all generated on the surface of *a*, in the spring of the first year, are, nevertheless, unfolded at different periods of the growth of the tree. In the first year, *e* only becomes a branch, on the surface of which *i* is generated; which in its turn generates *k*: in the second year *g* is unfolded and generates *l*: the third year brings forth *h*, and the fourth *f*. In these branches the age of each branch is clearly indicated, from *g*, which is one year old, to *e* which is four: but although this is the case, and *f*, which has sprung from an apparently adventitious bud, is not older than *k*, a secondary branch from *e*, yet the germs of all were generated on *a*, and consequently of the same date with the first developement of the trunk."*

The stem, the limbs, and the sprays of trees are thickly set with eyes, or germs of branches in readiness waiting for a favourable opportunity of increasing. The limbs of a large tree have frequently numbers of small young shoots on them, even along their whole lengths to the stem, in situations where sprays had, at an earlier part of the tree's life, been shed, but as the head increased in size, the thickly shaded part became more distant from the limbs, which circumstance rendered the limbs, again, suitable for sprays. At one time sprays are

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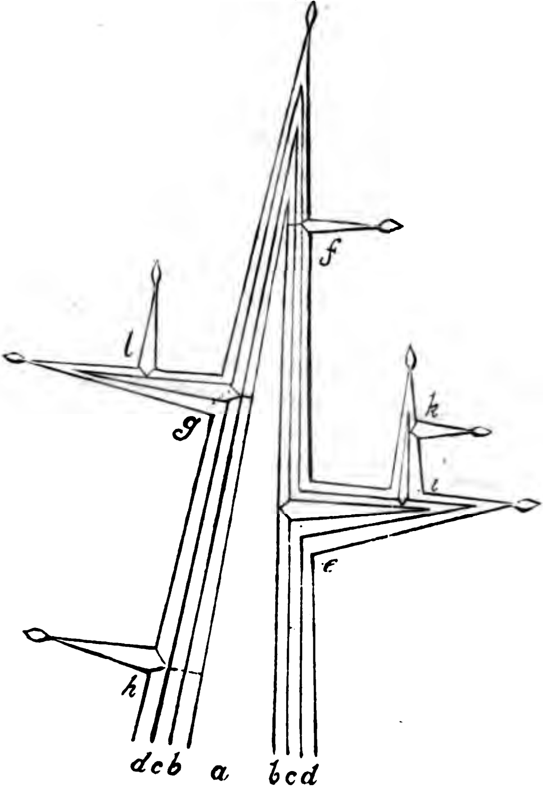
* L. U. K., Vegetable Physiology.

Fig 40.



See note at the end of the book.

shed because of the unfitness of their situation, which situation, in course of time, again becomes fit, and then again are sprays sent forth. If a grove of trees, with long stems clear of branches be thinned, the stems of the remaining trees, soon have young sprays on them, in the very parts where sprays had before been shed.

CHAPTER IV. — PRUNING.

OF PRUNING TO INCREASE THE GROWTH OF TIMBER.

Absurdity of the idea that any branches are robbers of the stem — Strong shoots sent forth after cutting, no proof of increased growth — Experiment proving that pruning retards the growth of trees — Stems of trees proportioned in size to the offices they have to perform — Great difference between thinning and pruning — Good effects of thinning plantations erroneously attributed to the effect of pruning — Pruning cannot be practiced without diminishing the quantity of leaves—Every leaf contributes towards the increase of the stem — No growth takes place without leaves.

The pruning of timber trees may be said to have for its objects; first, to advance the growth and bulk of trees: secondly, to improve their form; and thirdly, to improve the quality of the timber.

Pruners imagine that by taking off or lessening the side branches, the growth of the stem, or bole, is promoted; and as this is a very important part of our subject, I will first show that such is the opinion of many writers, and then endeavour to point out the fallacy of such opinion.

First, the celebrated Mr. Pontey considers certain of the side branches as robbers, and he says, in his Forest Pruner, page 166, "Pruning not only improves the form, but increases the size, or general weight of a tree. To some persons, it is presumed, the assertion may appear paradoxical, but not to such as will give due weight to the following considerations."

"When a branch, or a number of such, are displaced, an extra quantity of sap is thrown into the remaining part of the plant; of course, it must increase its vigour. And not only so, but we are certain that any branch so displaced is a certain degree of obstruction removed, *so far as the quantity of branches is more than necessary to the feeding of the stem.* Whatever causes an increase in the vigour of the top of the tree must do the same to the roots, which are in some sense no more than the mouths of the plant. The branches would not be seen extending themselves quicker and farther than ordinary in the air, if the root had not previously done the same in the earth. They are, by such means, not only increased in quantity, but have additional pasture, where they collect an increased portion of nutriment, which converted into sap, will ascend to the head, and in so doing enlarge the vessels or conductors. An increased quantity, with an amended circulation of sap, amounts to what may not unaptly be denominated an improved constitution; which repeated attention could not fail to preserve; and, therefore, we are warranted in asserting, that, under such circumstances, the general weight of the plant would increase much faster than before."

In Sir H. Steuart's Planter's Guide, the following remarks of the Author of the Encyclopædia of Gardening, are quoted. "The general effects of Pruning I have already stated to be of a corresponding nature with those of Culture, that is, to increase the quantity of timber produce. The particular manner in which it does this, is by directing the greater part of the sap, which generally spreads itself in side branches, into the principal stem. This must consequently enlarge that stem, in a more than ordinary degree, by increasing the annual circles of the wood." Sir H. Steuart, says—"No good phytologist will doubt, that it is according to sound science, as well as good practice, in woods planted for profit, and in a soil and climate which are natural to them, or below that standard, to cut away a small proportion of the weaker branches and turn the current of the descending sap more abundantly into the stems. Such retrenchment, however, must always be modified, by the actual wants of the trees, and the fair proportion which the size of the stem bears to the size and number of the boughs."—*Planter's Guide*, p. 443.

Now I say that pruning instead of increasing the quantity of timber, decreases the quantity in proportion to the extent or severity with which it is practised; that the pruning of ever so small a bough from a tree occasions a loss of means of forming timber; and observe that the latest and most approved methods of pruning, differ from the old only in being less extensive.

Trees with a superabundance of boughs, and trees with over-luxuriant shoots, pruners say, require to be pruned. If trees ever have more than enough boughs, it is possible pruning may be useful; but surely it would be proper to ascertain to a certainty that such disproportion exists, before any attempt be made to remedy it. Pruners should first prove that there are too many boughs, before they lessen them. Trees have never too many boughs; for every live bough supports leaves, and every leaf contributes its share to increase the size of the stem. Also it would be proper to ascertain the existence and evils of over-luxuriant boughs before the remedy be applied. Just observe that important part of our quotation from Mr. Pontey's Pruner, in italics, the argument to prove that pruning causes increased growth only applies to trees that have more branches than are necessary; and where is it shown that trees are ever so circumstanced?

Some branches are considered as robbers, appropriating to their own use that which would otherwise be more usefully employed in increasing the stem. All the branches are not considered as robbers; for no one advises that all should be cut off: and it is found absolutely necessary that some should remain on, or there would be no growth. Then if it be necessary that some sprays should remain on, some office must be performed by these remaining sprays; I shall, therefore, call them feeders; that is, the sprays that the pruner considers should remain untouched, are feeders, and the sprays he cuts away, robbers.

Pruners give no rule for distinguishing the robbers from the feeders. One would expect that there would be a considerable difference in the appearance of the two kinds of sprays, as their properties are so opposed to each other. Whether there be any difference or not, it does seem that pruners have not been able to discover it, or they certainly would have pointed it out in their instructions; for without some means of knowing, to a certainty, the robbers from the feeders, there is, in performing the operation of pruning, great danger of pruning off the feeders and leaving on the robbers; which occurrence would place the tree under most unfortunate circumstances. If some be robbers, and some feeders, it is of the utmost importance that the pruner should know the one from the other: and if all be feeders, and none robbers, who, knowing this, will cut any away for the reasons intimated in the works above quoted? Perhaps the pruner may say, that he does not class the boughs as above, into robbers, and feeders, but considers that the functions performed by all are alike; and that when there is a *superabundance* of boughs, they perform their functions in too great a degree; and that by reducing their number, the tree is brought to a state of health more fit for the increase or growth of the timber or woody part. This is the same as to say that the growth of a plant is promoted by having its health injured.

In speaking of the functions performed by boughs, I do not mean that the boughs alone are useful; but as no bough can be cut off without reducing the quantity of leaves, I say the functions of the bough, meaning the functions of all the parts supported on the bough.

Some are led to believe that growth is increased by pruning, from the apparently vigorous shoots sent forth by trees where their limbs have been pruned off, or by young trees when headed down.

Now I admit that stronger shoots may for the first year be obtained through lessening the head of a tree, but deny that the amount of growth in such tree is increased. In the winter a tree has its head cut off: the following summer several strong and long shoots spring forth, much stronger than any shoot would have been, had the head of the tree remained on; but this does not prove that the general growth is increased by the cutting off. The growth collected into these few strong shoots deceives only those who have not thought on the subject. The number of these shoots amounts, perhaps, to five or six; whereas, the head that was cut off, had fifty or sixty shoots, all of which, if the tree had been left alone, would have grown in length, and many more new ones would have been sent forth; also there would have been an annular layer of wood laid on every part of the head and stem, and the amount of the tree's growth would have been, far indeed, greater than that shown in the few vigorous shoots of the beheaded tree.

Some will say, this property of trees to send strong shoots when cut, is not considered an argument in favour of pruning to increase the quantity of timber, but it shows how the shape of a tree may be improved by pruning. To such who hold this opinion the present argument is not directed: the subject now is, pruning with an intention of increasing the quantity of timber; pruning to improve the shape of trees will come under observation farther on. It is admitted that stronger shoots are produced the first year after cutting, but this luxuriance of growth is soon discontinued, generally the first year after cutting, and it seldom lasts more than two or three years; probably through the quantity of roots being lessened in proportion to the branches. We know that when a tree has part of its roots destroyed, some of the branches die; and when some of the branches are destroyed, some of the roots die: "No one part can be affected without affecting the other parts." This decay of the roots, in consequence of the cutting off the heads, or boughs, I have repeatedly observed when taking up trees that had, a short time before, been cut off for grafting. This sending forth strong shoots, after being pruned, is an effort that it is the nature of the tree to make, to remedy any injury, or to replace parts necessary to its existence; yet this, many persons misunderstand, through not continuing their observations long enough, and consequently, they erroneously conclude that pruning increases the growth of trees.

Mr. Thomas Baylis, who is well acquainted with the nature of trees, and by whom my attention was first directed to the baneful effects of pruning, planted a bed of about five hundred Pear trees, at Ledbury, in the county of Hereford. Sixty of these trees were left entirely unpruned; all the others were pruned, with naked stems, as trees generally are in nurseries. The sixty unpruned trees had no advantage in soil or situation; yet, on an average, their growth in a few years was at least three times greater than that of the pruned trees. The unpruned trees were much better formed, for transplanting into orchards, than the pruned ones; their stems were furnished with strong thorny branches: these branches, in addition to the other good offices they had performed and were performing, to enable the trees to outgrow the pruned ones so far, made excellent natural fences for each against injury from cattle. It is not my intention to enter into an argument about the management of fruit trees, this experiment with the pear trees is only mentioned to show that the opinion that pruning decreases the quantity of growth, has been confirmed by experiment; but I cannot refrain from stating my regret at the present deplorable state of the orcharding in this county. The great ignorance of the nature of trees displayed in the management of apple and pear trees, almost dismays me in the attempt to point out the errors that are fallen into by the cultivators of timber-trees.

The apple and pear trees, in this county, are generally rendered fruitless at an early age through ill treatment. The apple tree, in particular, dies overpowered by the numerous injuries inflicted on it by its misjudging and officious cultivators. At a time of life when it should be in its greatest prosperity, it is falling to pieces with premature old age; its limbs are, one after the other, blown from its rotten trunk; and it may truly be said, that the apple-tree seldom dies a natural death; its death being generally occasioned by an accumulation of injuries.

Whenever a tree has a live spray cut from it, an injury is inflicted on that tree that never can be entirely repaired. Every wound received is stored up; and if wounds be continually added, they will accumulate to a degree too great to be borne, and the tree will sink under its infirmities.

It is useless to attempt to transfer the timber of the boughs to the stem, or to confine the growth of timber entirely to the stem. However desirable it may appear to the pruner, to have all the growth diverted to the increase of the stem, he never will be able to effect it. He may view the large limbs and numerous boughs of a tree, and imagine how much larger the stem would have been, had all the timber contained in those limbs and boughs been applied to the increase of the stem;

and he may, like the dog, snap at the shadow and lose the substance; but never will he be able, by pruning off boughs, to increase the growth of the stem one jot. No; the size of the stem will be in proportion to the head it has to support.

The stem is not, as he may imagine, a production formed merely for the use of man; it is the canal, or passage, in which the juices pass between the roots and the branches; and the size of this passage is always proportioned to the offices it has to perform. If the number of branches be increased, the quantity of sap passing between them and the roots will be increased; a greater space is necessary for this increased quantity of sap, and consequently the stem is increased. Let the head of a tree increase, and depend upon it, there will be a corresponding increase of the stem.

It is said to be right to cut away a small proportion of the weaker branches, and turn the current of the descending sap more abundantly into the stem. It is hard to understand what is meant by this explanation of the effect of pruning. Does the sap descend down the stem till it arrives at the weaker branches and then ascend up them and increase their size instead of that of the stem? If so, the weaker branches would soon become the stronger; or rather if trees have the property of sending the sap from the strong branches to the weaker, all branches would be equally strong. The descending sap on entering the weaker branches would become ascending sap. And if the small branches be considered as obstructions preventing the descent of the sap, the large branches must be greater obstructions. But where does the sap descend from? Pruners forget that they cannot cut a live spray from a tree without lessening the quantity of its leaves. Their theory is founded in error, and all their reasoning is false. Whenever they attempt to explain the manner in which pruning is beneficial, they are sure to broach some absurd notion or other. The best plan a pruner can adopt, if he wish to continue his business, will be, to refrain from attempting to explain how and why, pruning is useful.

In Mr. Pontey's Forest Pruner, to show the necessity of pruning, it is stated, that knots obstruct the sap, and a plate is given, showing the manner in which the sap is obstructed. Those who wish to inform themselves on the subject, instead of looking at this plate, should examine the reality: every board presents a section of the stem, or bough, from which it was cut: and in any boarded floor, a great variety of sections may be seen. Look to these, to see if the sap be obstructed by the knots. It will be found that there is the most admirable provision to prevent any obstruction at the knots, and that a tree is not such an imperfect piece of work as those who fancy they see its defects imagine.

It is strange that the knots should be fixed upon as an instance of the imperfection in the make of a tree, for there is no part of the structure more beautifully and wonderfully contrived. The large and heavy limbs of a tree, extending out, perhaps, thirty or forty feet from the stem, must be most admirably formed for strength where they are joined to the stem, to support the weight and the force of the occasional strong winds applied to so powerful a lever. The fibres or sap vessels are tied and bound round the boughs at the knots, so as to afford the requisite strength, and at the same time permit the passage of the sap unobstructed. Probably those who think the knots of trees obstruct the sap, may fancy the sap must be sadly obstructed by the thick, solid joints or knots in wheat straw. If nature has contrived a method for passing the sap through these, we need not doubt her power to do the like in trees.

Some say, that pruning is to the tree, what thinning is to the plantation. This is not true. The effect of pruning to a tree, is as different to that of thinning to a plantation, as it is possible for two effects to be. How can the cutting away surrounding obstacles, and the giving room for the increase of a tree, be the same as the cutting away the boughs of that tree, whereby its size is diminished, and incurable wounds are inflicted? In the one case, the tree remains unmutilated, and with an additional quantity of space to extend itself in; in the other, it has its size diminished, and also has received injuries that can never be cured. Pruners find it impossible that their practice can rest on its own merits, and, therefore, would wish to attribute to pruning the good effects of thinning. A piece of ground may be overstocked with cattle; drive a quantity of them away, and this evil is remedied: but would the effect be similar, if instead of driving certain of them away, you were to reduce the bulk of each individual, by cutting away its limbs or any other parts. Animals and vegetables are alike in these particulars; the growth of each may be promoted by improvement in situation or food, or by the removal of any injurious obstacle: and each is injured by any interference with the internal organization.

Persons are often deceived by taking the result of thinning for that of pruning. The two operations are generally performed at the same time, and sometimes the advantages of the thinning more than counterbalance the evils of pruning, and the good resulting from the thinning is attributed to the pruning.

One of the authors above quoted, is fearful that the timber may be injured in quality, by having its growth too much promoted by pruning. He may make himself perfectly satisfied on this head. Trees will not be made grow too fast by having their boughs cut off.

The inferiority of pruned timber, is not occasioned by its quick growth, but by dead knots, shakes, and rotten parts, the inevitable effects of pruning. We need not fear that timber would have its quality injured by having its growth promoted in any way, for there is reason to believe that the quality of timber does not depend on fast or slow growth, but on situation; and that exposed situations produce the firmest timber.

If men would make themselves a little acquainted with the nature of trees, they would be convinced how useless and silly it is, to attempt to improve a tree by any interference in the arrangement of its parts, and that the wisest course is, instead of depriving it of any, to lend their humble assistance for the preservation of all. A very little observation is sufficient to prove, that the size of any one part of a tree is determined by the size of the other parts; that no one part can be affected without affecting every other; and, therefore, that the pruning off live branches, can never increase the growth of timber, but on the contrary, must, of necessity, diminish the growth. Every spray taken off lessens the means of producing timber. Where sprays are pruned off, there is not only the loss of all the timber those sprays, or the leaves on them, were capable of producing by means of elaborating sap; but there is an irreparable damage done to the general growth of the tree. Dead parts are enclosed; the sap-conducting vessels that form the wood, are forced from their natural and most advantageous direction; and the space round about the head of the tree is filled with leaves in a less advantageous manner.

The operation of pruning cannot be performed on a tree without lessening the quantity of its leaves. "Leaves perform nearly the same functions in the vegetable economy which the lungs perform in that of the animal."* They are almost universal in the vegetable kingdom. Those few plants which are without leaves, have some other parts of their structure adapted for the performance of the offices of leaves; no growth can take place in any plant unless the functions of leaves are performed. Seeds and buds have the power of vegetating without leaves, but their vegetation seems to be the unfolding of parts that were previously formed, but lapped up.

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* L. U. K., Vegetable Physiology, part 1st, page 23.

The leaf is the first part of a plant that appears above ground from the seed; so important are the leaves, that a seedling seems almost impatient of waiting for their formation, and therefore, the cotyledons of the seed, in many plants, are converted into leaves. These seed leaves serve the office of leaves till other leaves are formed; the growth of the plant increases in proportion as its leaves increase, provided all the parts of the plant be healthy, and it be favourably situated. This proportion of the growth to the quantity of leaf, holds good both in herbaceous and woody plants.

The great importance of leaves is manifested in the buds of trees: each bud contains a spray, or blossom, or both, according to the nature of the tree: this spray, or blossom, is ready formed within the bud, although compressed into so small a compass. The bud manifests partly the same impatience for leaves as the seedling, as though it could not wait for their expansion, a temporary leaf (stipula,) is formed, which serves the office of leaves till the right leaves are expanded, or able to perform their own functions: these temporary leaves soon drop off or dry up. They surround and protect the young and tender leaves intended to remain on all the summer; any injury they may sustain from cold, or unfavourable weather, is of little consequence, as their duration is for so short a time. Whereas, injuries in the young leaves that are to elaborate sap the whole of the summer, would be of very bad consequence. "Every individual leaf of a tree is furnished with its own particular series of vessels for the course of the sap, and not only elaborates and prepares the sap for the increase of its own branch, but also for that of the parent stem and root."*

The trunk or stem of a tree is less above the boughs that may happen to be on it, than it is below them. This circumstance some persons think a proof that the boughs rob the stem: and those who prune under the idea that the limbs rob the stem, may be compared to those who, wishing to improve a river so that it may answer their purpose; and having surveyed it from its mouth to its source, say, "We find this river large and deep enough for our purpose from the sea up to where another river flows into it, where it immediately lessens and continues of the diminished size till another flows in where it lessens again, and higher up it is so reduced, that we lose it in a quantity of small streams. Now, having discovered the causes of the mischief, let us cut off, or stop these side streams, and we shall have a fine large river through its whole length, like that part below the confluence of the lowest side stream." But those who would reason thus, would not commit so great an error as the pruner does. The river in losing a side branch, only loses a supply; the tree in losing one, loses a supply, and also receives an irrecoverable wound, which the river does not.

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* Library of Useful Knowledge.

Those who fancy they increase the growth of a tree by cutting away its boughs, must be very ignorant of its nature. They seem to have a notion that the growth is solely produced by the roots; that the leaves are of little or no consequence; that a certain quantity of sap, or fluid, that causes the increase in the size of a tree, is sent up by the roots into the stem and branches, and that when a portion of the branches is cut off, an extra quantity of sap is left to increase the size of the stem and of the remaining branches. But, according to the same argument, the cutting off all the branches would still farther increase the growth of the stem: yet this is as good an argument as the advocates for pruning to increase growth can produce. They overlook the importance of the leaves. The sap that passes up from the roots cannot be applied to the enlargement of the tree till the leaves have rendered it fit for the purpose. It is as impossible to cause the sap, unelaborated by the leaves, to increase the bulk of a tree, as it would be to increase the growth of an animal by food, without permitting it to breathe.

Pruners say, they only reduce the size of the head *(or the quantity of leaves)* when it is not in due proportion to the stem. And how do they know when it is not in proportion; how do they detect this error of nature? Do they measure the surfaces of the leaves and the girt of the stem; or, are they led to the conclusion that the surface of leaf is too great, because nature is apt to commit blunders, and produce imperfect works? How they determine the exact quantity of leaves proper to be left on requires explanation. The truth is, they neither know nor care what quantity of boughs is sufficient: they cut away without rule, and are unable to give a single good reason for their practice.

Some will pretend that they have found by experience that pruning invigorates the tree, and increases its growth: but question them as to the experiments that have led them to this conclusion, and you will find they have never made any by which they have observed the comparative growth of pruned and unpruned trees.

The degree of pruning, or quantity of boughs cut off trees, is in proportion to the ignorance of the pruner. Those who are most ignorant of the nature of trees, cut away unmercifully; those who are more acquainted with their nature, cut less; and those who have the best knowledge of their nature, *never prune at all.* The truth of this observation any one may convince himself of by conversing with those who practise it in different degrees of excess.

The pruner may say, it matters not to us whether the stem of a tree be in proportion to the head; we care nothing about the nature of a tree: what does it signify to us if we cause the most unnatural thing in existence if we procure that which we want. If we procure a sound large stem, with never so small a head; we care nothing about its being in an unnatural shape. This I admit; it does not matter by what means the timber be produced; but can the effect intended be produced by the means employed? The pruner's attempts to obtain large stems with small heads, are on a par with those of the gardener, to obtain large onions by means of bending down their tops. The ignorant and short sighted destroy the cause that would bring forth the effect they want. The stem cannot be forced to grow out of proportion to the head; for the stem is the effect of the head, and the head, that of the stem: they are, as Sir H. Steuart observes, "cause and effect mutually; and no one can precede another, either in the order of nature, or of time."

I shall say no more of the effects of pruning on the growth of the timber; but recommend those who are not convinced that the quantity of timber cannot be increased by pruning, to fairly try the experiment, by pruning some trees, and leaving unpruned others, similarly situated. The best way to make this experiment would be to prune, and leave unpruned, alternate trees in the same plantation.

CHAPTER V.

OF PRUNING TO IMPROVE THE QUALITY OF TIMBER.

No union ever takes place between the old and new wood where boughs have been cut off—Superior quality of unpruned timber—Certainty of sound timber from unpruned trees—Defects of pruned timber.

With regard to the pruning for the purpose of improving the quality of the timber: I dont know in what manner it can be imagined to have this effect; for all the effects I know of are injurious to the quality of the timber. *It is a fact, not generally known*, that whenever a bough is cut from a tree, no union ever can take place between the wounded part and the new wood. The end of a branch, where cut off, may be imbedded in the new wood, but I believe there never can be a perfect union; I never could, in any of the timber I have seen sawed open, discover the slightest inclination in the new wood to unite with the end grain of a bough cut off; and no person has so good an opportunity of observing the effects of pruning, as he who is continually seeing pruned trees opened. Pruners would, perhaps, be more cautious were they continually to bear in mind, that every bough cut off near the stem, causes an irremediable blemish inthe timber. If the bough cut off, be too large for the new wood to grow over before decay takes place, a rotten part is enclosed, or partly enclosed; and very probably a hollow or rotten stem is the consequence; and if, either through protection, by means of cement or otherwise, the wound be covered by new wood before decay takes place, still there is a blemish in the timber; for the new and old wood will not unite. It is said by some, that the sap of wood will unite with the young or newly formed wood: but this is not true; no union ever takes place between any part of the end grain of a bough cut off, and the wood that is afterwards formed. Experienced timber-dealers know well that pruned timber is less valuable than unpruned timber, and that the more trees are pruned, the less valuable is the timber they produce. Trees that have never been pruned nor had their limbs, stems, nor roots mutilated, may be depended on as sound: their stems are almost certain to be free from decay, or any other kind of blemish, for this plain reason, because the whole of their substance, even to their centre is alive. It has been stated before, that when part of the roots of a tree are destroyed, some of its branches die; and that when part of its branches are destroyed, some of its roots die. Can it be wondered at then, that the stem, which is the channel of communication between the roots and branches, should be injured by having a portion of its substance rendered useless? So long as the fibres and tubes which compose the stem are kept in use, and have a stream or current of sap flowing in them, there is no chance of decay; it is impossible that decay can take place under such circumstances. How desirable then is it, that the circulation of the juices through the stem should not be stopped or checked. When the limbs of a tree are cut off, some of the sap vessels of the stem are rendered useless, and being of no use, they contract, and often decay. Their contraction occasions what carpenters call shakes; and in a tree that has lost many boughs, it may be seen that a certain portion of the middle of its stem has contracted and separated from a ring of live wood, which is at the outside of the stem, forming a hollow cylinder, enclosing the contracted dead wood in the centre.

This is a very common blemish in pruned timber; but it cannot be discovered till the stem is cut through. This is one of the least injurious effects that pruning can have on the quality of timber: the worst, and by far the most common is, decay, which is almost certain to take place at the part where a bough has been cut off, and which seldom fails sooner or later, to extend itself through the whole stem.

Pruning cannot improve the quality of timber by reducing knottiness. A live knot in timber every carpenter knows to be less hurtful than a dead one. It is impossible to reduce the number of knots by pruning, but almost certain that the number must be increased. Those who imagine that timber may, by pruning, be rendered less knotty, must know but little of that admirable property in trees, to adopt the best shape for their situation: they never could have compared the shape of a detached and unmutilated tree in an open situation, with that of one growing in a grove, and closely surrounded by other trees. Let them well consider what is the cause of the great difference in the forms of the two trees; and when they have discovered and well understand this, I will answer for them, they will not attempt to procure the long knotless timber of the grove, from the detached tree.

CHAPTER VI.

OF PRUNING TO IMPROVE THE SHAPE OF TIMBER.

The shape of timber depends on the situation in which it grews—Necessity for trees posesssing the power of varying their forms according to their situations—Fine trees preserved from mutilation in parks and pleasure grounds.

With respect to the pruning for the purpose of improving the shape of timber; what has already been said of the nature of trees, and their power of adapting themselves to the situation they may chance to be in, is sufficient to show the absurdity of the attempt to direct the shape, by the cutting away boughs; for it should be noticed, that the removal of a bough from a tree opens a space, and affords room for the growth of the embryo buds that are so thickly set in every part, waiting for a favourable opportunity for their growth.

The lower boughs of trees seem to be those which pruners generally condemn, perhaps from their convenient situation, and a wish to have long stemmed timber. Be the situation of the tree what it may the lower boughs are cut off. Treatises on pruning are written, directing various methods of performing the work, without hardly so much as mentioning the propriety of regarding the situation; rules are laid down, and supposed to be suitable to trees in all situations. This evinces a great ignorance of the nature of trees, as indeed, does every part of the pruner's practice. It is impossible that a tree can be thrifty with a long stem, without lower boughs, in an open and exposed situation. It is equally impossible that a tree can, when closely surrounded by others, as it would be in a grove, have large and long spreading lower boughs, and a short strong stem.

If we want long stemmed timber, we must have it from the grove or wood: if short and large, we shall find it in the detached and exposed tree. The pruner never can, with all his imaginary skill, procure from the detached and exposed tree, timber long-stemmed and free from knots, as from a grove; neither can he from the thickly planted grove, obtain short and strong stems. In spite of all his endeavours, trees will persist in trying to suit their shapes to their situations. There would be some little more reason in the attempts of men to direct the growth of trees, were they by any means to present obstacles to prevent the growth in such parts as they wished, and to leave only such parts open and suitable, as they wished the tree to grow in. What should we think of him, who wishing to divert a river at any point, attempted to do so by lading out the water as fast as it ran, instead of presenting an obstacle to the progress of the stream, where he wished to stop it? Verily we should think it was the work of a madman.

It should be considered, that the form of a tree is not the effect of accident or chance, but the result of rules incessantly acting, given for securing the most advantageous shape for the peculiarities of situation. As trees have not the power of locomotion, there is a necessity for their possessing the power of varying their forms according to their situations. It is the nature of a tree to take that shape that is best calculated for effecting the greatest quantity of growth capable of being produced in the situation it may chance to be in.

What is the reason the trees preserved from mutilation near gentlemen's seats, in parks and pleasure grounds, are so fine and valuable, and form such a contrast with those things, those pieces of trees, scattered over whole counties, and subject to the pruner's imaginary assistance? Their superiority in beauty and value, is not owing to their greater age, nor to the soil nor situation in which they grow; for those pieces of trees, as I have called them, may be older, and they have every circumstance as favourable to their growth as park timber, except that of being within the influence of the pruner's despoiling hand.

CHAPTER VII.

Concluding remarks, with some observations intended to prevent the cutting down timber at too early an age.

If the effect of pruning be what is in the foregoing pages stated, it may appear strange that the practice should be, at the present day, so generally admitted, and that the advantages of it should have been so long undenied. I scarcely know how to account for the singular ignorance that has hitherto prevailed of the nature of trees, but believe that, of late, men have begun to inform themselves on the subject. It is surprising that self-interest has not, long ago, directed the owners of timber trees to the best method of management.

Pruning is practised, to a very great extent, by persons whose interest leads them rather to check, than promote, the growth of trees. Tenants receive not the profits of the timber grown on the land they pay rent for, and they are aware of the injury their crops sustain under or near trees. They take no trouble to inform themselves whether or not the quantity of timber is increased, or its quality improved, in any way; it is sufficient for them to know, that trimmed trees are more to their advantage than untrimmed ones. They, by pruning, lessen the shading of their crops, and obtain a little brush-wood, and occasionally a few stakes, to stop gaps in hedges, indolently neglected to be planted with quick. But both the landlord's and tenant's interest would be promoted if, instead of trimming, one half the trees were cut down, and the other half left unmutilated; for the tenant, by trimming, does not entirely get rid of the shade, and the trash he obtains, is dearly bought at the wages given for it; and as for the landlords, they in vain wait from generation to generation for the growth of timber, which at last, when the unsightly things are cut down, and some inexperienced timber-dealer is cheated with them, bring but little money, far short of what the one half, if unmutilated, would have brought.

Where pruning is much practiced, the loss, through the injury to the quality of the timber, together with that through the retardation of its growth, is immense; but even a very small degree of pruning, is sufficient to occasion a loss equal to twenty year's growth. Now, supposing such to be the case, the owner of the trees sustains a loss, equal to the whole value of the trees, reckoning five per cent, simple interest.

A very few years would be sufficient to prove, by experiment, that the effect of pruning on the growth of timber, is what I have above described. In any young plantation, as before recommended, let one half the trees be left unpruned; the other half be pruned, the more the trees are pruned; the sooner will the superior size and shape of the unpruned tree appear. Let the experiment be fairly tried, and the truth of what is in this book stated, I am certain will be clearly proved.

Having, in the foregoing chapters, pointed out that it is the nature of a tree to attain the greatest perfection capable of being produced in the situation, and under the circumstances it may be placed; and that any interference on the part of man to correct, by cutting, what may, to him, appear wrong, does not only fail to effect the purpose intended, but also inflicts injury, by counteracting the efforts of the tree, and by making wounds; it may not be amiss to say a few words tending to prevent the cutting down of timber at too early an age.

The manner in which timber increases in bulk, most persons are aware, is by the addition of layers or coatings of wood, annually laid on. The thickness of these coatings, is in proportion to the rate with which the tree grows; but it is of the same thickness in a tree, when its stem is two feet diameter, as it was when but two inches diameter, supposing all circumstances affecting its growth equally favourable at all times. The quantity of timber, then, added each year to the stem, is in proportion to the circumference of the stem. The increase, to a stem two inches diameter, will be but one-twelfth of that to one two feet diameter, supposing them both of the same length, but as the larger stem would probably be much longer than the small one, the produce of the large still farther exceeds that of the small one. If the large one be twice the length of the small one, and their diameters in the above proportion, the annual quantity of timber formed on the large stem, would be twenty-four times that on the small one.

Supposing a tree, from the seed, to grow fifteen inches in length, and to form a layer or coating of wood three-sixteenths of an inch in thickness, each year. At twenty years of age, it will be twenty-five feet high, and twenty times three-eighths of an inch in diameter at the ground, which is seven inches and a half. The quarter-girt in the middle, will be about two inches and a half, and the cubical contents, reckoned according to the usual method of measuring round timber, will be one foot and one inch; say, one foot, as the length is taken to the very point of the small end. According to the above rate of growth, twenty years are spent in producing the first foot of timber.

Let us see what would be the annual increase of such a tree at eighty years of age, supposing it to grow at the same rate as it did the first twenty years. At eighty years of age, the tree will be eighty times fifteen inches high; this is one hundred feet, and it will be eighty times three-eighths of an inch in diameter at the ground; this is two feet six inches, and in the middle, or half way up the tree, the diameter will be one foot three inches, and the circumference, nearly four feet. The whole surface of the tree will be, four feet multiplied by one hundred feet—equal to four hundred superficial feet. In the eighty-first year of the tree's age, a coating of wood is laid over this surface, three-sixteenths of an inch in thickness. Four hundred superficial feet of board, three-sixteenths of an inch in thickness, is equal to six-and-a-quarter solid feet; say, six solid feet. This quantity is produced in one year. A tree, then, at this age, produces as much timber in one year, as six trees produce in twenty years, reckoning the first twenty years of their growth.

It may be thought that one hundred feet is too great a length to assume as the height of a tree at eighty years of age; but it should be considered that, in the above calculation, the timber produced on the side boughs is not reckoned: and though a tree at eighty years of age, may not have one straight stem one hundred feet long, yet its branches would have a surface at least equal to that of such a stem.

Notwithstanding the annual produce of the large tree so far exceeds that of the small one; to a person who has not considered the subject, the small tree will appear to grow the fastest: for the growth of the small tree is much greater, in proportion to its size, than that of the large one. The quantity of timber produced by a tree growing at the rate stated in the above calculation, at eighty years of age, would be but about one-sixteenth of the contents of the tree; whereas a tree, when young, will double its size in one year.

When any thing is doubled in size, or even made half as large again, the difference is very plain to the eye; but when increased by only one-sixteenth of its contents, the difference is not easily discovered. The growth of a tree becomes every year less apparent, notwithstanding the quantity of timber produced, is every year increased.

It is unfortunate that any one trusted with the management of timber-trees, should suffer himself to be misled by these appearances. A tree, when young, appears to grow luxuriantly, and to increase in size very fast; but as it becomes older, it gradually appears to grow slower and slower; when the impatient and deluded owner, imagining it has ceased to grow, lays the axe to its root, and it is cut down in the prime of its life and vigour.

Any one who is aware of the length of time a tree will, under favourable circumstances, continue to grow, must admit the truth of the above observation. It is quite within compass to say, that nine out of ten of the trees cut down in this country, are felled before they have attained half the size they would grow to, if left.

When a tree is favourably situated, in a good soil, and has never had the seeds of decay sown, by means of the destruction or mutilation of any of its parts, the length of time it will continue to grow, is much greater than most persons are aware of. The famous Golynos Oak, which was felled in Monmonthshire, in 1810, "had been improving upwards of four hundred years."* The whole quantity of timber in this immense tree was 2426 feet. Those who are so anxious to direct the shape of trees, and to obtain long stems, should be informed that the stem of this valuable tree was not more than ten feet long, clear of boughs; and yet the timber of the stem and limbs, when sawed, produced nearly six hundred pounds. It is not to be expected that every tree if left, would ever attain a size as great as that of this wonderful Oak: but it is probable that many young trees are cut down when they have every circumstance as favourable to their reaching this immense size, as the Golynos Oak had, when at an equal age.

The great size of this tree proves, that size cannot be taken as a criterion by which the proper time for cutting down may be judged. Though among a lot of trees, one may be ten times as large as any one of its neighbours, this largest tree may be the least proper of all to cut down. Therefore, in endeavouring to ascertain whether a tree has ceased to grow so as to increase its value, its size should not be at all considered. If the stem be sound, and the tree be in good health, it may be depended on that it is producing timber faster than ever it did at any former period of its life." The general appearance of the tree is, in most cases, sufficient to direct the judgment as to its health, and the soundness of its stem. If the tree has never lost any boughs, (and its appearance will mostly show whether it has or not,) there can be little doubt but the stem is sound: and with regard to its annual growth, this may be found very nearly, by cutting the stem with a small chisel, so as to see the thickness of the annual layer. The surfaces of the stem and boughs may be measured, and a very near estimate of the quantity of timber annually formed may be made.

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* Description of the Golynos Oak, published by Boydall & Co. Cheapside.

It is shown that the quantity of timber annually produced by a large tree, is much greater than that produced by a small one; but this is not the only advantage: large timber is more valuable than small. For instance, a quantity of Oak trees were, last year, (1832) cut down in this neighbourhood.* The small trees, such as contained about sixty feet of timber, the purchaser would have sold at two shillings and sixpence a foot; but the large ones, containing two hundred feet each, he would have been unwilling to sell, in the same situation, at six shillings a foot. The quality of the small timber was quite as good as that of the large: the greater value of the large, was solely owing to its superior size.

It is worthy of remark, that this timber, some of which was of very large dimensions, had never been pruned: it belonged to the late John Martin, Esq., M.P., and had been carefully protected by him and his ancestors from the devastations of the pruner. Aware of the ill effects of disarranging the operations of nature, they had permitted their trees to grow in all their native luxuriance, and, in consequence, many gigantic oaks, not excelled perhaps in any part of the kingdom, adorn the beautiful grounds on which they stand.

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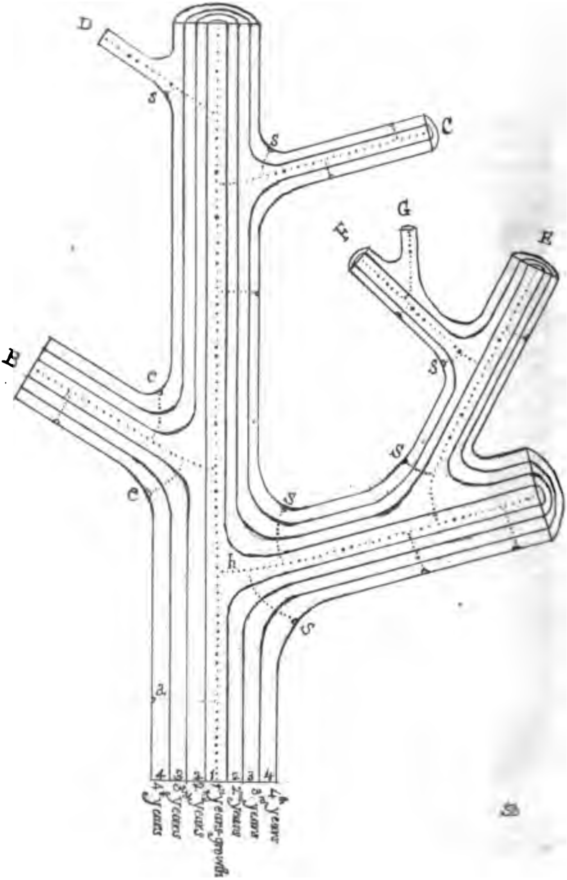
* Ledbury, Herefordshire.

The origin & connexion of Branches.



NOTE TO PAGE 32.

The letters, refering to the diagram, appear to be misplaced in the work on Vegetable Physiology, and in the copy I have given from that work; but this I did not discover till after that part describing it, was printed. The following description and accompanying diagram are intended to show more clearly the manner in which I understand the origin and connexion of branches to take place.

Let 1, 2, 3, 4, (see diagram), represent the first, second, third, and fourth years' growth of a tree or bough. In the first year's growth, the side shoot h, is produced; and also the germs furnishing the branches B, C, and D, which are sent forth in the second, third, and fourth years, respectively. Thus the branch D, is one year old; C, two years old; B, three years old; and A, four years old, notwithstanding all the buds that produced these branches, were formed in the first year's growth. In the second year, the secondary branch E, is produced, and the bud is generated, which, in the following or third year, forms the shoot F, and generates the bud that, in the fourth year, produces the spray G. The spray G, and every other spray, is provided with numerous buds; but those that are not situated favourably for extension, remain dormant, ready to take the first opportunity of growing. Thus the embryo bud a, which was generated in the first year's growth, would shoot forth immediately on the limb B being pruned off, as would also the buds e e, generated in the first year of the growth of B. But if the limb B remain on, very probably neither of these buds would ever shoot forth, though they would, each year, advance through the annual layer of wood, so as to be always at the surface, leaving a line or mark in the wood from the pith, which line and the pith are shown by the dotted lines.

At the basis of the boughs there are generally embryo buds, shown at s s s s s s, and e e; they are well situated to supply the place of the bough in case it be destroyed, and they afford an instance of one of those careful provisions, that produce that admirable and astonishing perfection, which is in all the works of nature.

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